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Tittel: "Et fleksibelt rørsystem, samt metode for fremstilling og bruk av slikt system"

P02057

A flexible pipe system, a method of manufacturing and a use of such a system

The present invention relates to a flexible pipe system for transporting gasses and/or fluids, said pipe system comprising a number of metal pipes. The invention further relates to a method of manufacturing such a pipe system and to a use of such a pipe system.

Rubber hoses are well suited for many applications and when provided with steel filament they may also carry quite high pressures e.g. for use in hydraulic systems. The property making the rubber hoses well suited is the high degree of flexibility, whereby the hoses may connect fixed parts with moving parts, and the hoses are durable even when subject to vibration. The material rubber, however, suffers from the drawback that at least some media in gas form may diffuse through the material. In vehicle braking systems, water enters into the braking fluid by diffusing through the braking hoses. In air-condition systems based on carbon dioxide, the carbon dioxide slowly escapes through rubber hoses, whereby poor function of the systems takes place and where time-consuming and costly refilling are necessary. A further disadvantage of rubber is aging. When rubber is subject to normal outdoor conditions, it moulders away and needs replacement every seven to ten years depending on the actual conditions.

One object of the present invention is to provide a flexible tube that does not allow media in gas form to diffuse through the sidewall of the tube. A further object is to provide a flexible tube which has a longer life span than a rubber hose.

The novel and inventive aspects of the pipe system, according to the invention, relate to the fact that the pipe system further comprises at least one cylindrical carrier made of a polymeric material, and to the fact that each of the pipes are wound or twisted along a longitudinal axis in order to increase the flexibility, said pipes being placed in at least one layer surrounding a core

carrier and/or being at least partly embedded in a protective carrier, and to that each end of the pipes is connected to at least one end piece, said end piece providing access to or from the pipes.

By winding or twisting the metal pipes the flexibility is increased, which is one of the desired properties. In many applications, such as e.g. in the automotive industry, gentle and careful handling of the pipes can not be expected when the obtained flexibility is exploited. That means that when the pipes are bent a risk of collapse arises, if the pipes are bend too sharply. For metal pipes this would mean that the pipes would have to be discarded. By applying at least one cylindrical carrier made of a polymeric material, and by placing the pipes in at least one layer surrounding a core carrier and/or being at least partly embedded in a protective carrier, one greatly decreases the risk of collapse by maintaining the pipes substantially in position. Also, the carrier may be provided with a larger stiffness than the pipes, whereby the carrier will carry the main part of a bending load applied to the pipe system. Further, due to the natural properties of polymers, the at least one carrier will have a damping function on the system, in case the system is subjected to vibration. Also, the use of metal pipes constitutes an impassable barrier for diffusion of media in gas form through the pipes. Further, the metal material may be chosen as a type with a higher life span than rubber or it may be surface treated to obtain the same.

In a preferred embodiment the pipes may be made of an aluminium alloy to obtain a light-weight and durable pipe system.

In another embodiment the core carrier and/or protective carrier may be made of an elastomeric material e.g. polyurethane. This provides a relatively high degree of damping of vibrations, both when used for the core carrier as well as when used for the protective carrier. Using polyurethane for the protective carrier provides an increased life span of the pipe.

In a further embodiment the pipes may be embedded in a protective carrier, said carrier comprising a central cavity. This ensures a low weight of the pipe

system, as well as the opportunity to circulate a cooling or heating medium via the central cavity for heat exchange with the medium in the pipes.

The surface of at least one pipe may be coated by a protective coating. The protective coating may inhibit corrosion and/or fretting or abrasion between the pipes or between the pipes and a core carrier. The protective coating may be a layer of polymeric material.

In another embodiment the longitudinal axis of the pipes may be placed in a distance from and parallel to the longitudinal axis of the carrier. This provides a very flexible construction since each pipe may be wound or twisted with a minimum pitch angle. The lower the pitch angle, the more flexible the pipes become.

In a further embodiment the longitudinal axis of the pipes may be placed concentrically to the longitudinal axis of the carrier. This may provide a more compact construction. Although the pitch angle is limited by the number of pipes wound or twisted at a time, the diameter may be larger and thereby provide high flexibility.

In yet a further embodiment the pitch angle of the pipes may be varied over the length of the pipes, in a way such that the pipe system comprises at least one section with a relatively lower pitch angle and at least one section with a relatively higher pitch angle. In this way the stiffness of the system may be varied in order to obtain that the pipe system will tend to bend more at some sections than at other sections. This is useful when the pipe system is to be led past a number of known obstacles.

In a still further embodiment the pipe system may comprise at least one pre-bent section, whereby it may be pre-formed to fit in a certain application.

In a preferred embodiment the pipe system may comprise at least two layers of pipes. This provides a larger flow area of the cross section of a pipe system, whereby a more compact construction is obtained. In case the pipes are placed concentrically, the diameter of the pipes limits the pitch angle and hence limits the flexibility. When using more layers, a lower pitch angle may

be used, since the necessary flow area may be obtained through the use of more pipes, said pipes, however, having a smaller pitch angle than what would be possible with only one layer.

In a further embodiment the pipe system may comprise at least one spiral section and at least one straight section. This provides a very large flexibility by the spiral section.

In a still further embodiment the at least one cylindrical carrier may be provided with varying bending stiffness along the length of the carrier. This provides an opportunity to control the deflection of the pipe system, when it is bent and attached for operation.

The invention further relates to a method of manufacturing a flexible pipe system, said method involving the novel and inventive aspects that it comprises the steps of:

- positioning a number of metal pipes around and substantially parallel to a cylindrical carrier made of a polymeric material,
- twisting the pipes around said carrier until a state of permanent deformation is obtained.

Through this method, a very easy and low cost manufacture is obtained. The cylindrical carrier ensures that all the twisted pipes obtain a diameter approx. as the diameter of the carrier, thereby assuring uniformity.

At least one of the pipes may before twisting be fixated in at least one end piece. In this way the end piece may be used to apply the necessary twisting force. In case several pipes are fixated in the end piece, this will ensure the relative positions of the pipes during deformation and further convey uniformity of the pipe system.

A preferred use of a pipe system, according the aforementioned, is in a vehicle, e.g. a car for transporting a pressurized medium. Generally, there is a number of difficulties involved when designing products for the automotive

industry. The components must be very durable, since they are exposed to heat from the engine and to a salty mist from wet, salted roads in the winter (corrosive environment). Also, the components are subjected to a high degree of vibration, said vibration coming from e.g. the engine and from driving on uneven, coarse surfaces. All these hurdles are overcome by the pipe system of the present invention.

A preferred use of the pipe system concerns the transporting of carbon dioxide in an air-condition system. For this use metal pipes constitute a barrier, which the carbon dioxide is unable to diffuse through. Therefore, this solves the problem of refilling carbon dioxide on the air-condition system.

In the following the invention is described with reference to the drawings, which display examples of embodiments of the invention.

Fig. 1	shows a side view of a pipe system according to the invention.
Fig. 2	shows a side view of another embodiment of a pipe system.
Fig. 3	shows a side view of a further embodiment of a pipe system.
Fig. 4	shows a side view of a further embodiment of a pipe system.
Fig. 5-6	show a cross section of an embodiment of a pipe system similar to section A-A of Fig. 3.
Fig. 7	shows a cross section of an embodiment of a pipe system similar to section B-B of Fig. 4.
Fig. 8-10	show cross sections of an embodiment of a pipe system similar to section A-A of Fig. 3.
Fig. 11	shows a side view of an embodiment of a pipe system.
Fig. 12	shows section C-C of Fig. 2.

Fig. 1-4 display pipe systems 1 comprising wound or twisted pipes 2 and end pieces 4. The end pieces 4 may be used to assemble the flow paths of the pipes to one common flow path or oppositely to distribute one flow path into the pipes 2. In Fig. 2 and 3 the pitch angle V is shown. The pitch angle is the angle into which the pipes are wound or twisted. The pipes 2 may be wound

or twisted into any shape e.g. helical, spiral, coil, as well as they may be with a varying pitch angle or diameter, or with combinations of any such shapes.

In Fig. 1 un-wound or un-twisted straight and parallel pipes 2 have initially been placed with each end into two end pieces 4 (only one is shown) with an unshown core carrier 10 placed centrically to the pipes 2. Following the end pieces 4 have been twisted relative to each other, and thereby also the pipes 2, until the pipes 2 have obtained a permanent twist and maintain the depicted shape. This is a preferred way of manufacturing the system 1. The pipes 2 would normally be glued, brazed or welded to the end pieces 4 to form a tight connection. After these processes the system 1 may further have a polymeric protective carrier 12 cast around them, whereby they are at least partly embedded. Alternatively the core carrier may be removed before the protective carrier 12 is added.

Fig. 5 and 6 display pipe systems 1, where multiple pipes 2 are placed to surround a cylindrical carrier, which in these cases are core carriers 10. The core carrier is made of a polymeric material, preferably an elastomer such as polyurethane. In Fig. 5 the pipes are placed in one layer 6, whereas in Fig. 6 the pipes are placed in two layers 6 and 8. With more layers, a larger flow area may be obtained, thereby decreasing the flow resistance through the pipe system without increasing the outer diameter of the system 1.

Fig. 7 displays a pipe system 1, where a number of wound or twisted pipes 2 are placed at a distance from and parallel to the longitudinal axis of a core carrier 10 comprising a central cavity 11.

Fig. 8 displays a pipe system 1, where six pipes 2 are placed to surround a core carrier 10.

Fig. 9 displays a pipe systems 1, where six pipes 2 are placed to surround a core carrier 10. The pipes 2 are further embedded in a protective carrier 12.

Fig. 10 displays a pipe system 1 comprising multiple pipes 2 placed in two layers 6 and 8. The pipes 2 are embedded in a protective carrier 12 comprising a central cavity 11.

Fig. 11 displays a pipe system 1 comprising end pieces 4 and a spiral section 14 and a straight section 16. This design is well suited for applications requiring very high flexibility. Of course the pipe system may comprise further spiral and/or straight sections.

Fig. 12 displays an end piece 4 comprising mounting holes 18 distributed in a suitable pattern for receiving the pipes 2. The holes 18 are connected to a central opening 20.

The pipe system 1 may be used in high pressure systems carrying gas, air, water, steam, petrochemicals or any other substance in order to allow individual movement of the equipment and the connecting lines. The system 1 may also be used in braking systems on vehicles and other means of transport.

It is to be understood that the invention as disclosed in the description and in the figures may be modified and changed and still be within the scope of the invention as claimed hereinafter.

Claims

1. A flexible pipe system(1) for transporting gasses and/or fluids, said pipe system comprising a number of metal pipes(2) **characterised in that** the pipe system further comprises at least one cylindrical carrier(10,12) made of a polymeric material, and in that each of the pipes(2) are wound or twisted along a longitudinal axis in order to increase the flexibility, said pipes(2) being placed in at least one layer(6,8) surrounding a core carrier(10) and/or being at least partly embedded in a protective carrier(12), and in that each end of the pipes(2) is connected to at least one end piece(4), said end piece(4) providing access to or from the pipes(2).

2. A pipe system according to claim 1, wherein the pipes(2) are made of an aluminium alloy.

3. A pipe system according to claim 1 or 2, wherein the core carrier(10) and/or protective carrier(12) is made of an elastomeric material.

4. A pipe system according to one or more of claims 1-3, wherein the pipes(2) are embedded in a protective carrier(12), said carrier comprising a central cavity(11).

5. A pipe system according to one or more of claims 1-4, wherein the surface of at least one pipe(2) is coated by a protective coating.

6. A pipe system according to one or more of claims 1-5, wherein the longitudinal axis of the pipes(2) is placed at a distance from and parallel to the longitudinal axis of the carrier(10,12).

7. A pipe system according to one or more of claims 1-5, wherein the longitudinal axis of the pipes(2) is placed concentrically to the longitudinal axis of the carrier(10,12).

8. A pipe system according to one or more of claims 1-7, wherein the pitch angle(V) of the pipes(2) is varied over the length of the pipes(2), in a way such that the pipe system comprises at least one section with a relatively

lower pitch angle(V) and at least one section with a relatively higher pitch angle(V).

9. A pipe system according to one or more of claims 1-8, wherein the pipe system(1) comprises at least one pre-bent section.

10. A pipe system according to one or more of claims 1-9, wherein the pipe system(1) comprises at least two layers(6,8) of pipes(2).

11. A pipe system according to one or more of claims 1-10, wherein the pipe system(1) comprises at least one spiral section(14) and at least one straight section(16).

12. A pipe system according to one or more of claims 1-11, wherein the at least one cylindrical carrier(10,12) is provided with varying bending stiffness along the length of the carrier.

13. A method of manufacturing a flexible pipe system(1), comprising the steps of:

- positioning a number of metal pipes(2) around and substantially parallel to a cylindrical carrier(10) made of a polymeric material,
- twisting the pipes(2) around said carrier(10) until a state of permanent deformation is obtained.

14. A method according to claim 13, wherein at least one of the pipes(2) before twisting is fixated in at least one end piece(4).

15. Use of a pipe system(1) according to any of claims 1-12 in a vehicle, e.g. a car, for transporting a pressurized medium.

16. Use according to claim 15, wherein the pipe system(1) is used for transporting carbon dioxide in an air-condition system.

Abstract

A flexible pipe system, a method of manufacturing and a use of such a system

The present invention relates to a flexible pipe system(1) for transporting gasses and/or fluids, said pipe system comprising a number of metal pipes. The invention further relates to a method of manufacturing such a pipe system and to a use of such a pipe system. The novel aspects of the invention involve that the pipe system further comprises at least one cylindrical carrier(10,12) made of a polymeric material, and that each of the pipes(2) are wound or twisted along a longitudinal axis in order to increase the flexibility, said pipes(2) being placed in at least one layer(6,8) surrounding a core carrier(10) and/or being at least partly embedded in a protective carrier(12), and that each end of the pipes(2) is connected to at least one end piece(4), said end piece(4) providing access to or from the pipes(2). The pipe system(1) may be used to replace rubber hoses in a number of applications, where unwanted diffusion through the rubber occurs.

(Fig. 1)

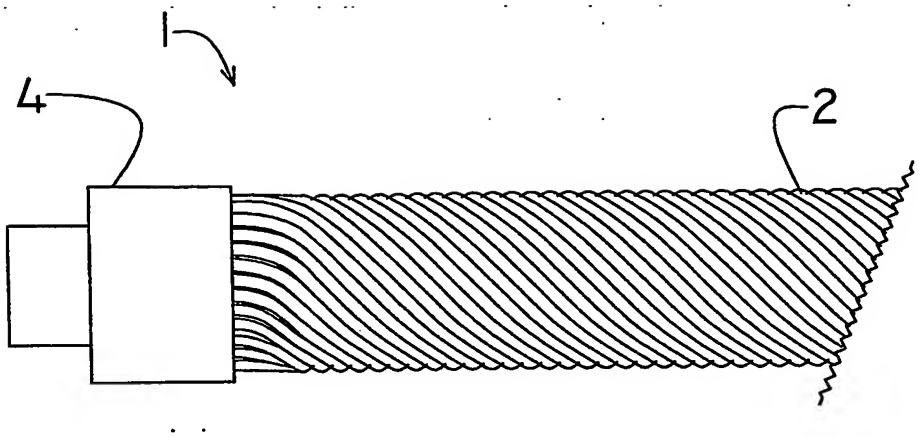

Fig. 1

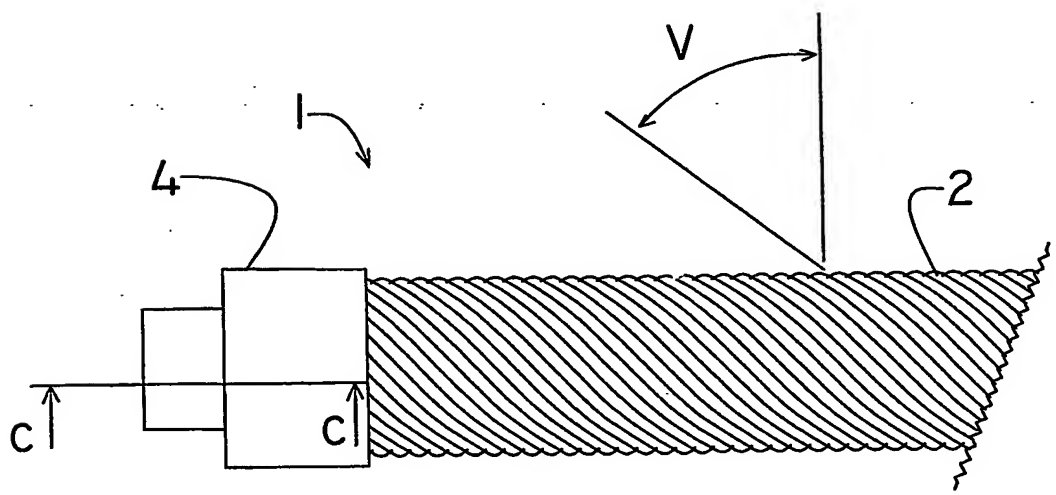

Fig. 2

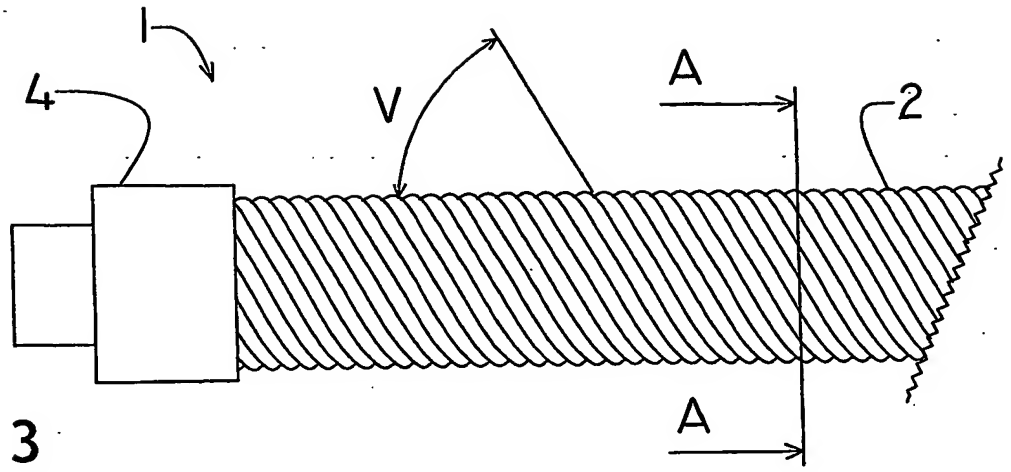

Fig. 3

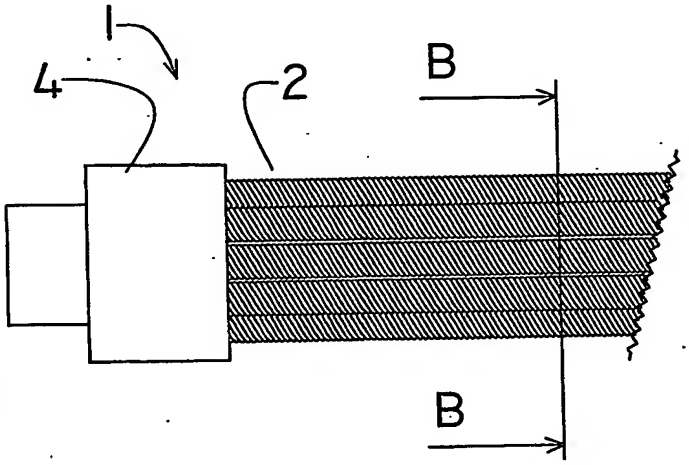

Fig. 4

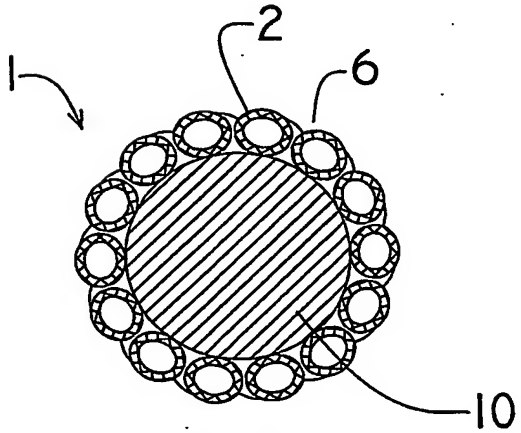

Fig. 5

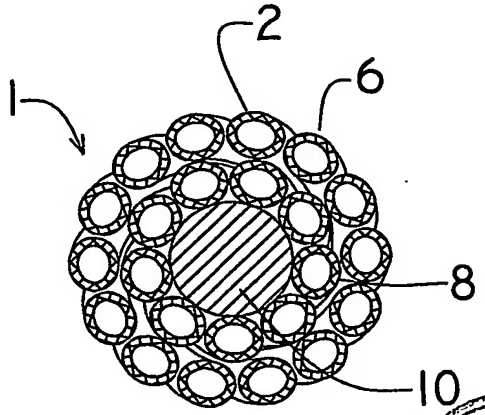

Fig. 6

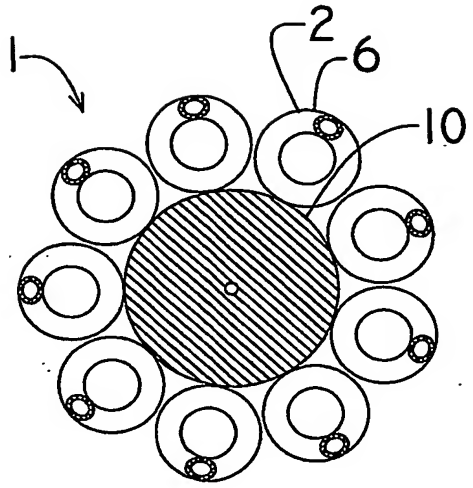

Fig. 7

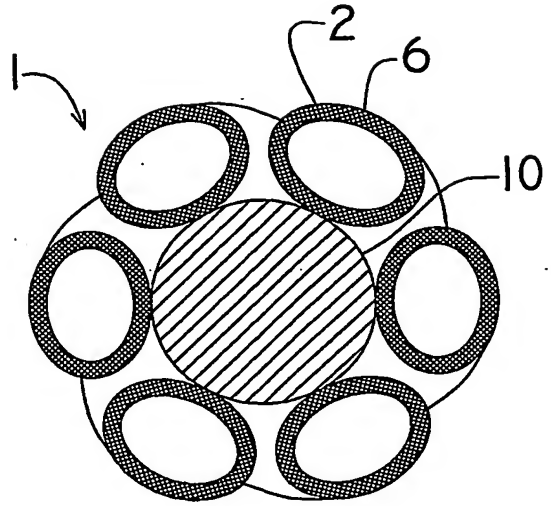

Fig. 8

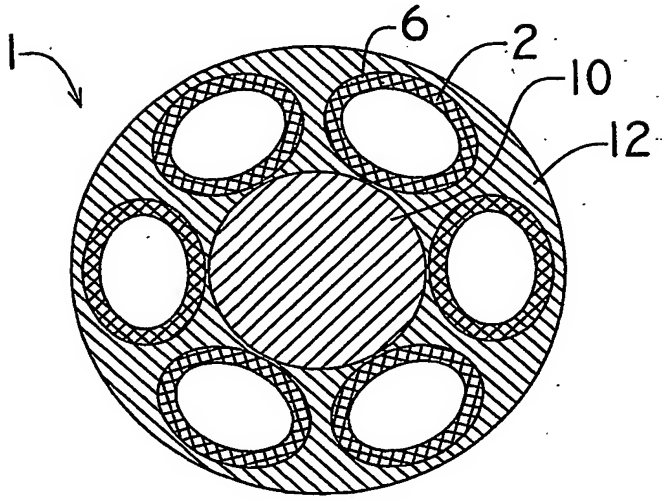

Fig. 9

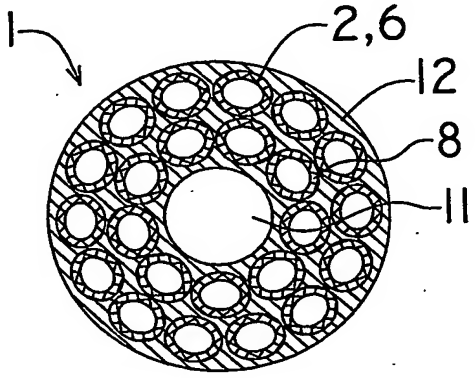

Fig. 10

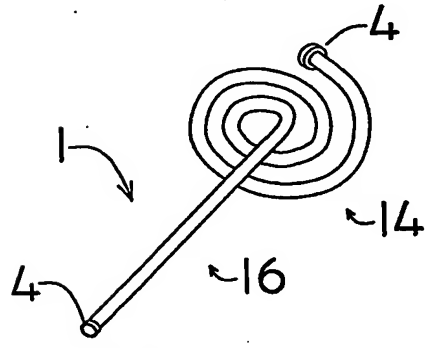

Fig. 11

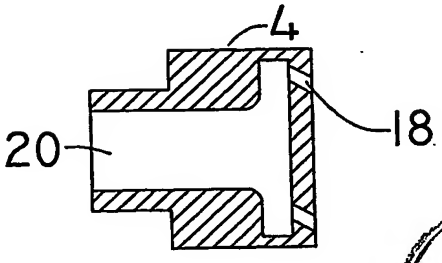

Fig. 12